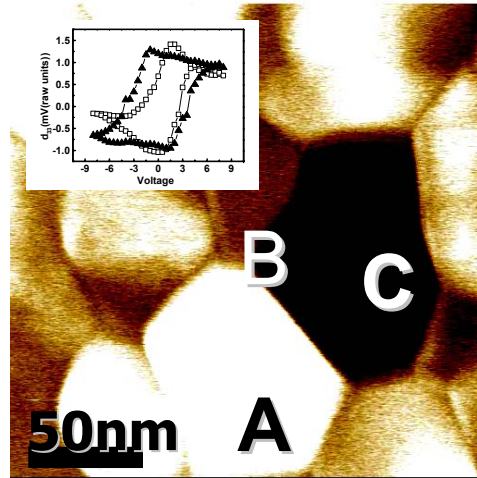
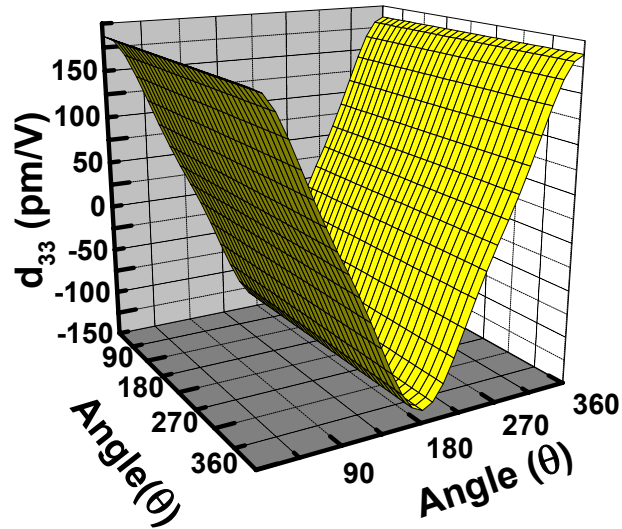


Nanoscale Ferroelectric and Piezoelectric Phenomena in Oxide Heterostructures

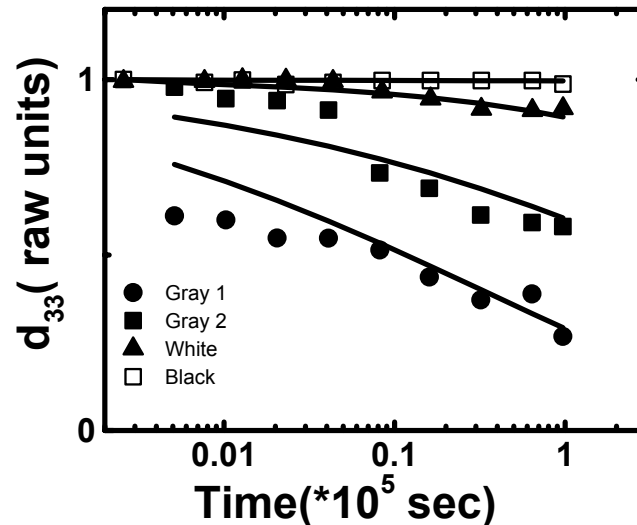
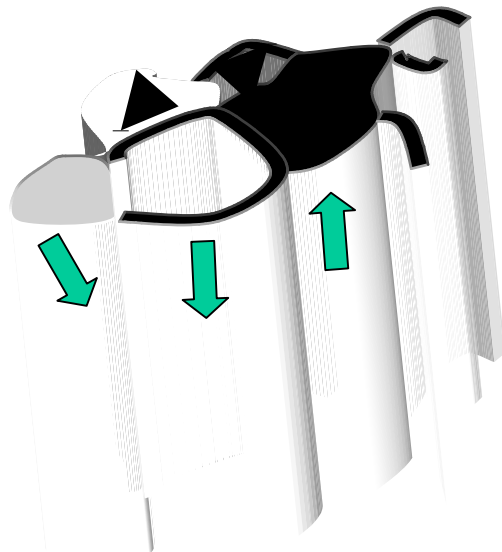
NSF-Europe Collaborative Program, DMR - 0427815

V. Nagarajan, R. Waser* and R. Ramesh#

**IWE Juelich, Germany and #University of California, Berkeley*

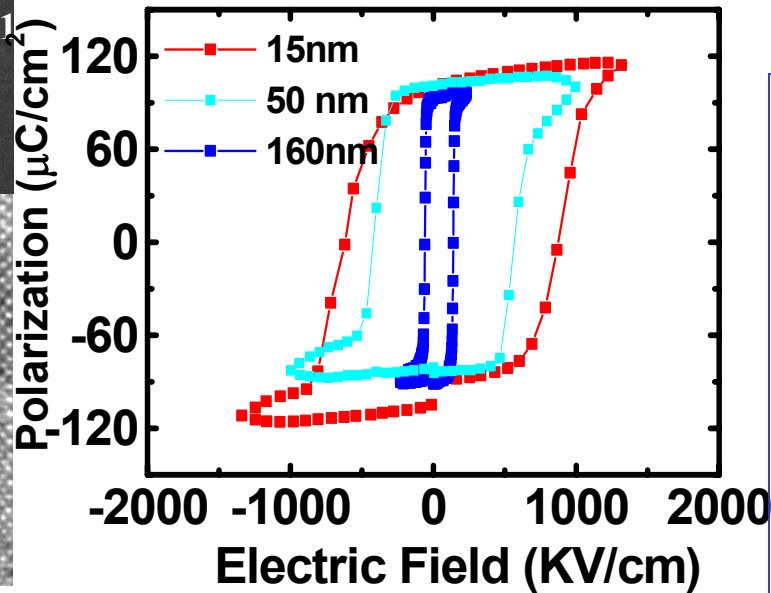
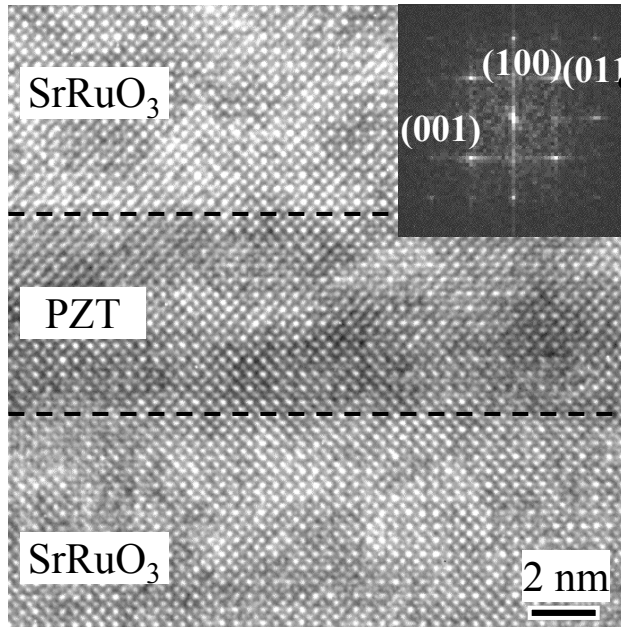


In this Nugget we report on the study of nanoscale polarization relaxation phenomena in polycrystalline PZT films. Piezoresponse force microscopy (PFM) images of the as-grown sample reveal grains with a range of contrast, from fully white to gray to fully black. This local change in the contrast (magnitude) of the piezoresponse from grain to grain is due to the crystallographic orientation within each grain. PFM based relaxation experiments show that the rate of relaxation is different for each grain, furthermore is strongly dependent on the tilt of individual grain with respect to the polar axis. Strongly tilted grains show a much stronger decay of the polarization compared to polar axis oriented grains. This has significant implications for the stability of domains in polycrystalline films used in memory devices



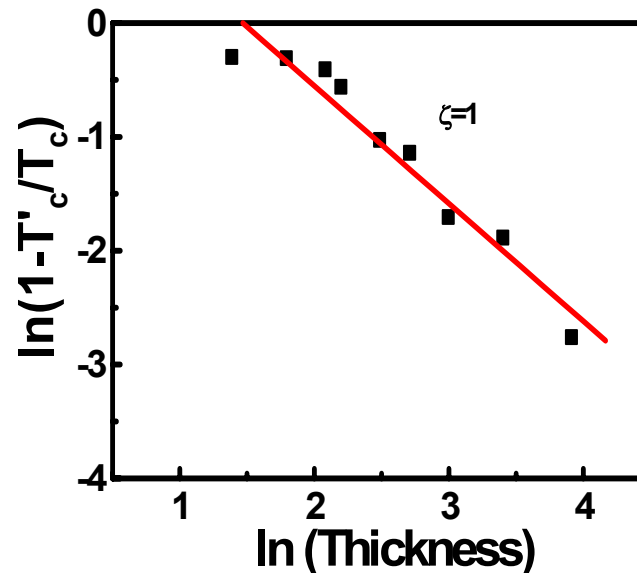
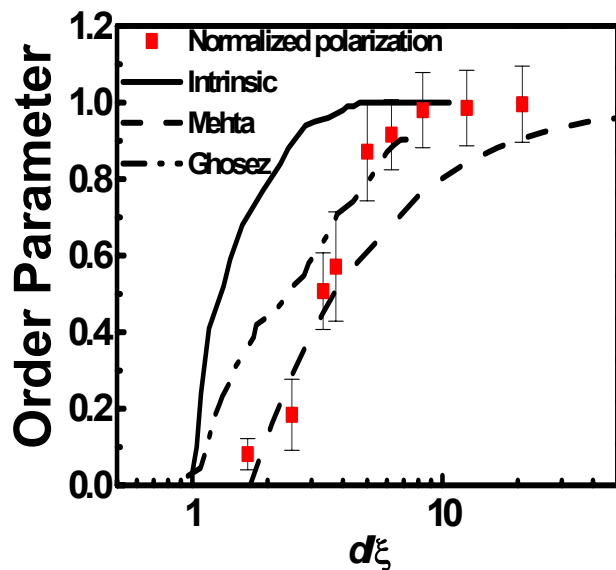
Applied Physics Letters, submitted

Size Effects in Ferroelectric Heterostructures



In this Nugget we show a systematic quantitative experimental and theoretical study of the thickness dependence of switched polarization in (001) epitaxial PZT films, 4 to 80 nm thick. A preliminary model based on a modified Landau Ginzburg approach suggests that the nature of the electrostatics at the ferroelectric-electrode interface plays a significant role in the scaling of ferroelectric thin films.

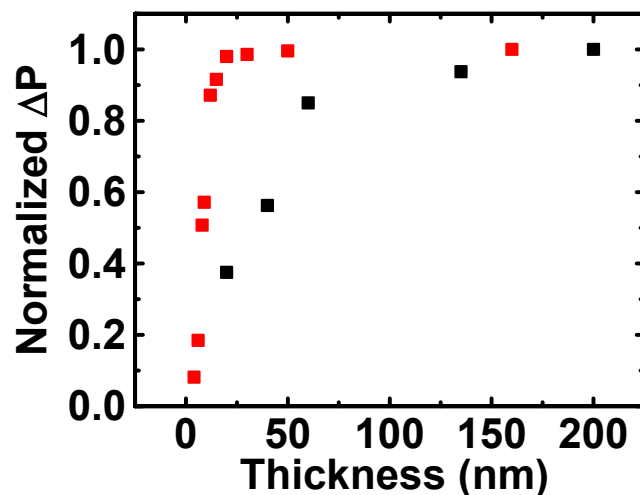
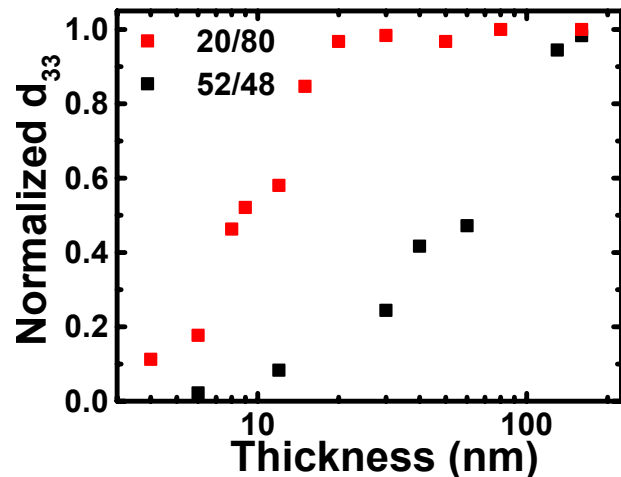
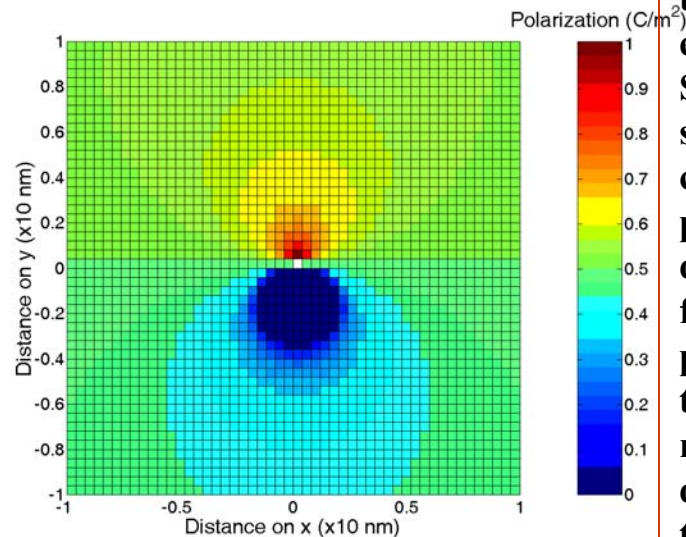
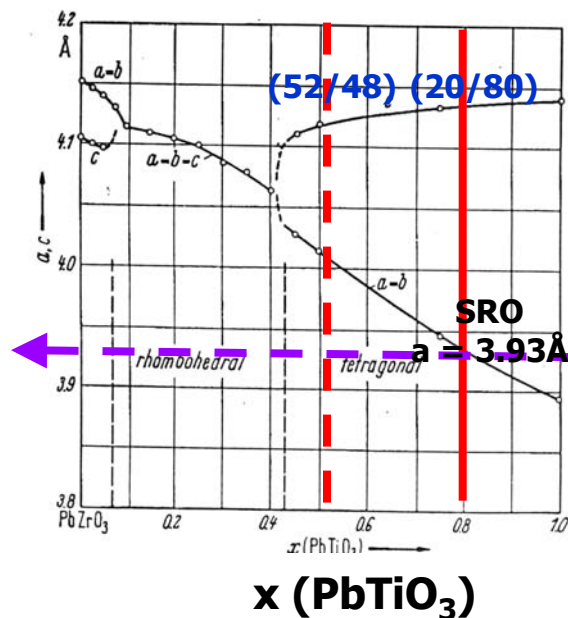
Applied Physics Letters, 85, 5225(2004)



Misfit Dislocation Induced Polarization Degradation in Ferroelectric Heterostructures

V. Nagarajan, H. Kohlstedt and R. Waser, S. P. Alpay and R. Ramesh

IWE, Juelich, Germany; University of Connecticut; University of California, Berkeley



We present a quantitative study of the thickness dependence in epitaxial PZT films grown on SrRuO₃ buffered SrTiO₃ substrates. Theoretical calculations present a physical picture for the effect of such dislocations in suppressing ferroelectricity. Both the polarization and the Curie temperature are predicted to drop rapidly around the core of a dislocation, gradually improving to the bulk value over a distance of 5-10 nm. This leads to highly localized polarization gradients and hence depoling fields, which would destroy the long-range interactions necessary for ferroelectricity. Piezoresponse measurements show that d_{33} for the PZT(50/50) system begins to get suppressed at a thickness much greater than that in the lattice matched PZT(20/80) thin films.

Nature Materials, submitted